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Interplays of psychometric abilities on learning gross anatomy

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Abstract

In recent years, there has been international debate concerning how students learn anatomy. The rapid increase in scientific knowledge has put pressure on the place of anatomy within the medical and allied health professional curricula, as well as the design and structure of anatomy courses. In this regard, relatively little is known about what medical and allied health professions students want from an anatomy course or how they learn it. To assess students' learning approaches and perceptions of anatomy, a series of psychometric tests were administered to Medical (n=82), Podiatry (n=21), and Pharmacy (n=74) students in the United Kingdom. Analysis of the Anatomy Learning Experience (ALE) questionnaire revealed a predominantly positive attitude towards anatomy and the dissection room, with most valuing cadaveric dissection and not regarding it as a daunting environment. Further to this, analysis of the Approaches to Studying Inventory for Students (ASSIST) revealed predominant preferences for strategic and deep approaches. Personality traits were associated with certain learning approaches; neuroticism with surface (p=0.038), conscientiousness with both a deep and strategic approach (p=0.000 and p=0.060 respectively). Certain personality traits were also found to be associated with anatomy experience e.g. neuroticism and achievement striving felt the most effective way to learn was to get their hands in and feel for structures (p=0.044 and p=0.012 respectively). This study concludes that undergraduate students of medicine, podiatry and pharmacy learn anatomy in slightly different ways. Preparation for classroom activities should centre on the promotion of an optimum learning environment and teaching strategies which promote a deep approach to learning. Understanding students' personality and learning experiences should help teachers improve the students' learning of anatomy for effective application to clinical practice.

Keywords: learning anatomy, spatial ability, approaches to learning, learning styles, anatomy education, reflective practice, assessment, scholarship, conscientiousness, personality

Introduction

Anatomy has long been a cornerstone of medical education and its history as a discipline is a testament to that (Carmichael et al., 2002; Turney, 2014). Alongside changes in the culture of medicine, anatomy has evolved from an art into a science and is considered by some to be a 'hazing ritual' for young medical students (Dyer & Thorndike, 2000). How students learn anatomy is a question that has long been pondered by researchers. Although we know performance is indeed affected by how students learn (Smith & Mathias, 2011), isolating cause and effect relationships is particularly challenging due to the complexities of the multivariate teaching environment.

Anatomy's vital role in medicine and allied health professions is indisputable and concerning that it is subject to increasing litigious claims, especially linked to damage to underlying structures (Turney 2007; Ellis 2002). The growth in medical and scientific knowledge and cuts worldwide to curricula have left the medical community with what some describe as 'Anatomy Deficit Disorder' (ADD) (Reidenberg & Laitman 2002) and concern that doctors in practice feel that recent graduates' lack of knowledge endangered safe medical practice (Waterson & Stewart 2005; Prince et al., 2005). Recent developments in core syllabi (Smith et al., 2016) have answered the 'what do I need to know' question but the 'how do I learn and understand it' remains unanswered and as learners continually evolve (DiLullo et al.,

2011); it will continue to change. Yet, some core components of cognition and learning are stable and provide a window into the learning process. To better understand how students, learn anatomy, it is necessary to look at several different constructs that contribute to learning. This article uses a range of psychometric tests to assess these constructs, including: approach to learning, personality and spatial ability. These are related to anatomy as a discipline by using the anatomy learning experience questionnaire (Smith & Mathias, 2009).

Approach to learning

Research by Marton and Salijo (Marton & Saljo, 1976) began to unravel how students achieved varying degrees of understanding (Ward, 2011). These approaches were termed, Deep, Surface and Strategic. Recent studies in anatomy have illustrated that students who utilize a deep approach outperform those using a surface approach (Smith and Mathias 2009; Ward, 2011). This finding has consistently been replicated and so has propelled curricular reforms designed to encourage deep learning (Newble et al., 1988). It is important to not confuse learning approach with learning styles which have been shown to be based on limited evidence and the theory of learning styles is now not substantiated. An approach is not a fixed trait and depends on context (Newble & Entwistle, 1986). That is, it is not possible to categorize a student as a 'deep learner' because their approach can change depending on the academic task. For example, a syllabus overburdened by facts may encourage rote learning and a predominantly surface approach, even amongst "good students" (Entwistle et al., 1989) Therefore, it is important to consider learning approaches as part of a teaching-learning system in which students are the product of a symbiosis between the learner and his/her environment.

In anatomy, different studies have explored learning approaches, Pandey explored the quality of work and students' own perceptions of the best approach to learning anatomy and found that visualization and understanding was associated with deep approaches to learning anatomy (Pandey & Zimitat, 2007). Memorization strategies, on the other hand, were reported by more students who adopted a surface approach. Similarly, a significant correlation between surface approach scores and lower exam performance, while a there was a small correlation with deep approach scores and higher exam results has been found (Smith & Mathias, 2010).

Several studies emphasize the malleable nature of learning approaches revealing how various aspects of course design and assessment canhave an influence. For example, allowing students to tailor their own learning outcomes during dissection increased interest and deepens learning (Findlater et al., 2012). Team work has been shown to facilitate active learning as promotion of a deep approach as students were more engaged when discussing topics together (Vasan & DeFouw, 2005). The role of assessment has been investigated and in an example where daily mini-quizzes were used they were found to significantly improved exam performance (Poljicanin et al., 2009). However, whether this can be attributed to a deep- or strategic approach is debatable. It has also been found that students become increasingly strategic as the program of study progresses. (Azer, 2011). Similarly, Böckers saw a shift towards a surface approach in their control group as the semester progressed (Bockers et al., 2014). These studies all confirm that approach to learning is plastic and relates to many different factors of the learning experience.

Personality

In personality research, there is widespread acceptance of the "Big Five" model, and this theory has dominated the field over the past three decades. The Big Five refers to five broad domains that are used to describe, categorize and measure personality in non-clinical populations, and these domains have demonstrated validity and reliability across occupational groups, cultures, measures, and rating sources (Barrick & Mount, 1991; Digman, 1990; Judge et al., 1999; Judge & Ilies, 2002; John & Srivastava, 1999; Salgado, 1997). The domains include *neuroticism* (individuals high on neuroticism tend to be emotionally unstable, pessimistic, anxious, and insecure), *extraversion* (individuals high on extraversion tend to be sociable, positive, assertive, and seek excitement), *openness to experience* (individuals high on openness tend to be curious, imaginative, and broadminded), *agreeableness* (individuals high on agreeableness tend to be caring, altruistic, cooperative, and empathic), and *conscientiousness* (individuals high on conscientiousness tend to be dependable, organized, and hard-working) (Chamorro-Premuzic et al., 2007; Lievens et al., 2009).

A large body of evidence has converged on the importance of conscientiousness across a range of occupational sectors and performance outcomes. Higher levels of conscientiousness have been found to consistently predict better job performance and academic achievement (Barrick & Mount, 1991; Chamorro-Premuzic & Furnham, 2003; Lievens et al., 2002; McAbee & Oswald, 2013; O'Connor & Paunonen, 2007; Poropat, 2009; Richardson et al., 2012). Conscientiousness has also been highlighted as an important predictor of performance in medical education (Doherty & Nugent, 2011). A longitudinal study investigating personality and performance across a medical school found that conscientiousness was a strong predictor of performance in all years and its predictive validity increased over time, as did those for extraversion and openness (Lievens et al., 2009). Staff and peer ratings of professionalism in medical school have been positively associated with conscientiousness behaviors (Finn et al., 2009; McLachlan et al., 2009), and higher levels of conscientiousness have been associated with better medical student performance on anatomy examinations (Finn et al., 2015) and diagnostic tests in a pathology course (Helle et al., 2010).

The Big Five personality domains may also be analyzed at the facet level. Each domain comprises multiple facets that describe lower-order personality traits, and facet-level analysis has been recommended by several researchers to achieve a more detailed understanding of specific elements of personality (O'Connor & Paunonen, 2007). Given the importance of conscientiousness for learning and performance this study focused on facet-level analysis of this domain in the current study. Using the International Personality Item Pool (Goldberg, 1999) measure, based on the NEO-PI-R personality inventory (Costa & McCrae, 1992), conscientiousness was composed of six facets: orderliness, dutifulness, achievement-striving, self-discipline, self-efficacy, and cautiousness. Individuals high on *orderliness* are organized, tidy and planful; those with high levels of *dutifulness* feel obliged to fulfil their commitments and tend to behave according to ethical principles. Individuals who score highly on the *achievement-striving* facet tend to work hard and set high expectations, are goal-directed, and possess a drive for personal success. Those high on the *self-discipline* facet tend not to procrastinate and are typically motivated to start and complete tasks despite distractions. Individuals high on *self-efficacy* possess confidence in their competence and ability to complete tasks successfully. Finally, highly *cautious* individuals tend to think carefully and consider the consequences before deciding or acting (Costa & McCrae, 1992; IPIP, 2016).

Although evidence at the facet level is more limited, several studies have described the relationships between conscientiousness facets and performance. In their review, O'Connor & Paunonen (2007) reported that achievement-striving and self-discipline were the strongest and most consistent predictors of academic achievement, also noting that dutifulness predicted academic performance in some studies. In medicine, a positive correlation between achievement-striving and anatomy examination performance in medical students was reported (Finn et al., 2015), and in their longitudinal study of Flemish medical students, Lievens et al. (2009) concluded that self-discipline, achievement-striving and self-efficacy were the strongest facet-level predictors of medical school performance.

Personality and Learning Approaches

Research has demonstrated that personality domains are differentially related to learning approaches, (Zhang, 2003). Duff et al. (2004) reported that extraversion is positively related to deep and strategic learning approaches, openness to experience is positively related to deep and strategic approaches, neuroticism is negatively related to deep and strategic approaches but positively related to a surface approach, and conscientiousness is positively related to deep and strategic approaches to learning. Extraversion and conscientiousness have been positively related to deep and strategic learning approaches; openness to experience was also positively related to deep learning; and neuroticism was positively related to surface learning (Chamorro-Premuzic & Furnham, 2009). A further study reported a positive correlation between conscientiousness and a deep learning strategy, an achieving learning strategy, and an achieving motivation; and a negative correlation between openness to experience and a surface learning strategy (von Stumm & Furnham, 2012). In medicine, a deep approach was greatest in students found with higher levels of extraversion and openness to experience, a strategic approach was associated with higher levels of conscientiousness but low levels of openness, and a surface approach was greatest in those with low levels of extraversion and openness (McManus et al.,2004).

The aim of this study was to explore whether relationships exist between learning approaches (deep, surface, strategic), the Big Five personality domains, the facets of conscientiousness, and perceptions of anatomy education (ALE) of students studying anatomy for different disciplines (Medicine, Podiatry and Pharmacy) allowing the variability in each discipline to be examined but to also ascertain the common themes which are pertinent to anatomy irrespective of professional program. For medical students, relationships with examination performance were also investigated. Based on the existing literature our hypothesis was that there are relationships especially between a deep approach and the facets of conscientiousness. This in turn would allow us as educators to better understand students so that the learning environment can be improved to respond to the needs of students and offer a more personalized experience.

Context

This study involved three different programmes of study: Medicine, Podiatry and Pharmacy.

Medicine

Brighton and Sussex Medical School founded in 2004 is a joint venture between the Universities of Brighton and Sussex. The curriculum is a five year MBBS. The program is divided into three phases. Phase one includes Years 1 and 2 where students are taught basic and clinical sciences in a hybrid spiral module based around themes. In year 1 the themes are: Foundation of Health and Disease, Heart, Lungs and Blood, and Nutrition, Metabolism and Excretion. In year 2 the themes are: Neuroscience and Behavior, Endocrinology and Reproduction, Musculoskeletal and Immune systems. Students study anatomy in a spiral approach (Evans & Watt 2005) using lectures, module tutorials, dissection practicals, living anatomy and ultrasound practicals. Students are assessed via summative knowledge test paper that includes two components; short answer and single best answer papers that incorporate anatomy pictures. Students are also assessed formatively after each module in a group anatomy viva. All anatomy assessments are considerate of the taxonomy levels that can be applied to anatomy (Smith & McManus 2015).

Podiatry

The University of Brighton three year BSc (Honors) Podiatry programm has run successfully since 1992 and is regulated by the Health and Care Professions Council (HCPC). The curriculum considers the foot and lower limb of a person in health and disease, with theory and practice carefully integrated to enable students to achieve the expected high standards of clinical expertise. Using student centered approaches, emphasis is placed on a case based strategy of learning and teaching enabling the students to understand the context and rationale for teaching the traditional subjects of anatomy, physiology, neurology and pathology. Functional anatomy and biomechanical principles are applied across the entire curriculum, but the learning of morbid and surface anatomy is concentrated in year one. Learning is promoted through human dissection, practical sessions, cases, lectures and hands-on biomechanical assessment of the foot. Formative assessment is through applied tasks relating anatomy with clinical practice, and summative learning is currently assessed through an Objective Structured Clinical Examination (OSCE) and Short Answer exam paper.

Pharmacy

The University of Brighton MPharm curriculum is a 4-year program, taught in the School of Pharmacy & Biomolecular Sciences at the University of Brighton. The program follows an integrated case-based approach which is spiraled over the first three years, with the 4th year preparing students for practice and research. In Years 1-3, students acquire knowledge of the physiology and pathology underlying various disorders (from single to multi-system), the chemistry and pharmaceutical considerations of the drugs used for their treatment and the relevant aspects of pharmacy practice and legislation. Students learn through lectures, workshops, tutorials, lab practical's, and simulated patients within the university, working with real patients on their placements over the 4 years. Assessments range from single best answer to short and long answer questions, plus Objective Structured Clinical Examinations (OSCE).

Methods

Ethical approval was given by the Brighton and Sussex Medical School Research Governance and Ethics Committee (13/177/SMI). Permission from the Director of Programmes/Head of School was obtained to access students.

First year medical, podiatry and pharmacy students were invited to take part in the study; there were no exclusion or inclusion criteria except that they should be registered on the appropriate degree program. Both online and verbal announcements were delivered to the students entailing details of the study. Following a lecture, students were asked to complete a range of psychometric tests. These included an Approaches to Study Skills Inventory for Students (ASSIST) –an Anatomy Learning Experience (ALE) questionnaire, a 50-item measure of the Big Five personality domains (neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness) and a 60-item measure of the six conscientiousness facets (orderliness, dutifulness, achievement-striving, self-discipline, self-efficacy, and cautiousness) from the International Personality Item Pool (Goldberg, 1999), based on the NEO-PI-R personality inventory (Costa & McCrae, 1992). Only medicine and podiatry students took part in the ALE as these students have active teaching experience using human cadavers.

Degree Program	ASSIST	Personality	ALE
Medicine	82/136 60% (58.5% F)	82/136 60% (58.5% F)	82/136 60% (58.5% F)
Podiatry	21/31 68% (80.9% F)	21/31 68% (80.9% F)	21/31 68% (80.9% F)
Pharmacy	70/138 51% (54% F)	74/138 54% (54% F)	N/A

Table 1. Participants and gender ratios.

The Likert-scale results were manually entered in an excel spreadsheet, using student identity numbers to maintain anonymity. ASSIST scores were calculated according to the ASSIST inventory guidelines (Entwistle, 2006), the result involve total scores for each approach and then generation of a dominant preference. Data was transferred into IBM SPSS version 22 for further analysis. For medicine, student's examination results were correlated. Personality was compaired to approach to learning using a 2-tailed Pearsons' correlation. The ALE

question answers were examined in relation to the Big Five domains and six facets of conscientiousness using a Spearmans' correlation. A Kruskal-Wallis test performed to examine the relationship between ALE and approach to learning and between personaility and discipline.

Results

Approaches to Studying Inventory for Students (ASSIST)

Analysis of the Approaches to Studying Inventory for Students (ASSIST) revealed a similar pattern between programs; students studying medicine adopting more of a strategic approach (51%) followed by a deep approach (47%). An equal adoption between deep and strategic (43%) for podiatry students and a deep approach followed closely by strategic (45%, 37%) for pharmacy students was found (Table 2).

ASSIST	Deep	Strategic	Surface	Equal Preference
Medicine	38 (47%)	42 (51%) *	2 (2%)	0 (0%)
Podiatry	9 (43%)*	9 (43%)*	3 (14%)	0 (0%)
Pharmacy	31 (45%)*	26 (37%)	7 (10%)	6 (8%)

Table 2. Summary of ASSIST results *dominant approach

Personality

An independent samples Kruskal-Wallis Test demonstrated that all the Big Five personality facets varied significantly between the different disciplines (Extraversion p=0.001, Conscientiousness p=0.000, Agreeableness p=0.000, Openness p= 0.007, Neuroticism p=0.018). The specific facets of conscientiousness also revealed variation between the disciplines with statistically significant differences between student groups on Self-efficacy p=0.00, Dutifulness p=0.024 and Achievement-striving p=0.000.

Personality	Ext	Con	Agr	Open	Neur	SelfE	Ord	Dut	Ach	SelfD	Caut
Medicine											
Mean:	3.55	3.70	4.14	3.69	2.40	3.87	3.61	4.17	3.95	3.32	3.57
SD:	0.62	0.54	0.45	0.62	0.56	0.32	0.60	0.37	0.48	0.70	0.45
Range:	2.60	2.40	2.40	3.30	2.90	1.70	2.90	2.12	2.00	3.30	2.40
Podiatry											
Mean:	3.36	3.39	3.79	3.47	2.79	3.46	3.70	3.97	3.67	3.06	3.25
SD:	0.50	0.52	0.34	0.61	0.61	0.35	0.32	0.31	0.45	0.66	0.54
Range:	2.10	2.40	1.10	2.20	2.20	1.10	1.00	1.10	1.70	2.50	2.00
Pharmacy											
Mean:	3.17	3.37	3.81	3.41	2.60	3.64	3.72	4.00	3.65	3.15	3.45
SD:	0.57	0.51	0.56	0.51	0.63	0.42	0.62	0.52	0.52	0.55	0.61
Range:	2.70	2.10	2.20	2.40	3.10	2.20	3.16	2.30	2.65	2.80	2.70

Table 3. Summary of personality results (Big Five, Ext-Extraversion, Con- Conscientiousness, Agr- Agreeableness, Open- Openness, Neur- Neuroticism, six conscientious facets- SelfE-Self-efficacy, Ord- Orderliness, Dut-Dutifulness, Ach--Achievement-striving, SelfD-Self- discipline, Caut- Cautiousness)

Analysis of the Anatomy Learning Experience (ALE)

The ALE questionnaire was only taken by the Medical and Podiatry students. Analysis revealed several questions which produced a consensus amongst students. Firstly, questions relating to dissection revealed a predominantly positive attitude towards the use of cadavers. Students agreed that using the dissection room (DR) specimens was an effective way of learning anatomy, especially when using their hands to feel for structures and it taught them other things such as natural variation. When asked if using cadaveric material was an important part of becoming a doctor or a podiatrist, most students strongly agreed. Students also generally disagreed that the dissecting room was a daunting place to be but felt that the amount to learn was daunting. Almost all students recognized the value of learning anatomy; the majority also denied not finding anatomy important because of their chosen specialty. Finally, the large majority of students appeared to find textbooks a useful resource for learning anatomy.

In medicine, it was possible to undertake further analysis to correlate the ALE responses with students' knowledge test (Single Best Answer and Short Answer Questions). A Spearman correlation revealed that answers to two ALE questions had significant correlations with the students' (total) exam results, as summarized in Table 3.

ALE Question	Correlation Coefficient	Significance (2-tailed)	Minimum Significance
22. I have problems using my anatomy knowledge because I am not confident in my knowledge base.	- 0.329	0.003	<>
24. I find I am using anatomical terms and language at most clinical opportunities.	0.223	0.047	<>

Table 3. Medicine ALE correlations to total knowledge test examination result.

Relationships between Approach to Learning, Personality and the Anatomy Learning Experience

A 2-tailed Pearson's correlation revealed significant associations between personality traits and approach to learning (Table 4). A nonparametric Spearman's correlation coefficient was performed to test for significance between personality and anatomy learning experience (Table 5). To test for relationships between approach to learning and anatomy learning experience a Kruskal Wallis test was performed and confirmed to ascertain which approach to learning through histogram (Table 6).

Approach to Learning	Personality
Surface	Neuroticism p=0.038 (r=0.156*)

Deep	Conscientiousness p=0.000 (r=0.273**) Agreeableness p=0.014 (r=0.185*) Openness p=0.000 (r=0.265**) Dutifulness p=0.002 (r=0.231**) Achievement-striving p=0.002(r=0.236**) Cautiousness p=0.008 (r=0.201**)
Strategic	Conscientiousness p=0.000 (r=0.398**) Agreeableness p=0.005 (r=0.208**) Self-efficacy p=0.042 (r=0.154*) Dutifulness p=0.000 (r=0.267**) Achievement-striving p=0.000 (r=0.313**) Cautiousness p=0.001 (r=0.250**)

Table 4. Significant relationships between personality and approach to learning * correlation is significant at 0.005, ** correlation is significant at 0.001 level.

ALE Questions	**Personality**
3. I find/found material provided by the course an effective way of learning anatomy e.g. Handbooks.	Neuroticism p=0.010 (r=0.251*)
4. I find/found using imaging material e.g. MRI an effective way of learning anatomy.	Extraversion p=0.030 (r=0.214*)
6. I find/found Dissecting Room specimens an effective way of learning anatomy.	Agreeableness p=0.011 (r=0.250*) Openness p=0.016 (r=0.252*) Self-efficacy p=0.001 (r=0.314**) Achievement-striving p=0.004 (r=0.280*)
7. I find/found clinician based teaching an effective way of learning anatomy	Conscientiousness p=0.045 (r=0.198*) Achievement-striving p=0.019 (r=0.231*)
8. The most effective way I learn/t anatomy in the Dissecting room is/was to get my hands in and feel for structures.	Neuroticism p=0.044 (r=-0.199*) Achievement-striving p=0.012 (r=0.246*)
9. The most effective way I learn/t anatomy in the Dissecting room is/was in groups.	Agreeableness p=0.010 (r=0.254*) Cautiousness p=0.007 (r=0.262**)

11. I feel that I learned/am learning other things whilst in the Dissecting room e.g. natural variation.	Agreeableness p=0.048 (r=0.195*) Openness p=0.013 (r=0.239*) Dutifulness p=0.021 (r=0.227*) Achievement-striving p=0.023 (r=0.224*)
12. I feel that working with Cadavers helped me to positively address the issue of death.	Dutifulness p=0.045 (r=0.198*) Self-efficacy p=0.049 (r=0.195*) Neuroticism p=0.034 (r=0.209*)
13. I find/found the amount of anatomy I need/ed to learn daunting.	Conscientiousness p=0.045 (r=-0.248*) Agreeableness p=0.032 (r=-0.212*) Self-efficacy p=0.020 (r=-0.229*) Self-discipline p=0.012 (r=0.247*) Dutifulness p=0.029 (r=-0.215*) Achievement-striving p=0.001 (r=-0.312**)
14. I believe that the anatomy resources within the School are limited.	Neuroticism p=0.042 (r=0.201*) Agreeableness p=0.011 (r=-0.25*) Self-efficacy p=0.027 (r=-0.217*) Extraversion p=0.020 (r=-0.230*) Dutifulness p= 0.008 (r=-0.262**)
16. I have problems learning anatomy because the teaching styles do not suit me.	Achievement-striving p=0.038 (r=-0.205**)
17. I feel course assessments do not reflect the learning that occurs.	Conscientiousness p=0.012 (r=0.248*) Dutifulness p=0.026 (r=-0.219*) Achievement-striving p=0.000 (r=-0.358**) Cautiousness p=0.026 (r=-0.219*) Self-efficacy p=0.002 (r=-0.298**) Self-discipline p=0.031 (r=-0.212*)
18. My main motivation for learning anatomy is to pass exams.	Extraversion p=0.029 (r=-0.215*) Conscientiousness p=0.010 (r=-0.254**) Agreeableness p=0.020 (r=-0.216*) Openness p=0.000 (r=-0.366**) Self-efficacy p=0.004 (r=-0.281**) Achievement-striving p=0.000 (r=-0.395**) Self-discipline p=0.047 (r=-0.196*)

19. I find anatomy learning difficult because it is memorisation based.	Conscientiousness p= 0.009 (r=-0.257**) Self-efficacy p=0.020 (r=-0.230*) Achievement-striving p=0.001 (r=-0.314**)
20. I struggle to build on my anatomy knowledge as I often forget what I learnt last semester/year/s.	Conscientiousness p=0.001 (r=-0.333**) Agreeableness p=0.028 (r=-0.217*) Neuroticism p=0.035 (r=0.208*) Self-efficacy p=0.000 (r=-0.374**) Orderliness p= 0.045 (r=-0.198*) Achievement-striving p=0.000 (r=-0.433**) Self-discipline p=0.000 (r=-0.298**)
21. I feel the medicine course allows me to quickly use my anatomy knowledge.	Conscientiousness p=0.00 (r=0.279**) Agreeableness p=0.011 (r=0.250*) Orderliness p=0.031 (r=0.347**) Dutifulness p=0.005 (r=0.277**) Achievement-striving p=0.000 (r=0.411**) Self-discipline p=0.000 (r=-0.257**) Self-efficacy p=0.000 (r=0.347**)
22. I have problems using my anatomy knowledge because I am not confident in my knowledge base.	Conscientiousness p=0.000 (r=-0.358**) Dutifulness p=0.003 (r=-0.315**) Agreeableness p=0.004 (r=-0.279**) Self-efficacy p=0.000 (r=0.347**) Achievement-striving p=0.001 (r=-0.315**) Self-discipline p=0.001 (r=-0.257**)
24. I find I am using anatomical terms and language at most clinical opportunities.	Conscientiousness p=0.000 (r=0.347**) Self-efficacy p=0.036 (r=0.206*) Self-discipline p=0.002 (r=0.233*)
25. I find I use my anatomy radiology knowledge frequently in clinical situations.	Extraversion p=0.031 (r=0.212*) Self-efficacy p=0.035 (r=0.208*)
26. I find I use my surface anatomy knowledge frequently in clinical situations.	Extraversion p=0.002 (r=0.300**)
28. I feel that understanding anatomy is a very important part of becoming a doctor.	Conscientiousness p=0.031 (r=0.215*) Openness p=0.006 (r=0.267**) Self-efficacy p=0.039 (r=0.203*)

29. I feel that working with cadaveric material is an important part of becoming a doctor.	Extraversion p=0.015 (r=0.238*)

Table 5. Significant relationships between personality and anatomy learning experience. * correlation is significant at 0.005, ** correlation is significant at 0.001 level.

ALE Questions	Approach to learning
6. I find/found Dissecting Room specimens an effective way of learning anatomy.	P=0.008 Surface Approach
10. I feel the Dissecting room is a daunting environment to learn in.	P=0.002 Strategic Approach
11. I feel that I learned/am learning other things whilst in the Dissecting room e.g. natural variation.	P=0.028 Surface Approach
12. I feel that working with Cadavers helped me to positively address the issue of death.	P=0.000 Surface Approach
18. My main motivation for learning anatomy is to pass exams.	P=0.001 Strategic Approach

Table 6. Significant relationships between approach to learning and anatomy learning experience

Discussion

Exploring the relationships between factors that influence the learning experience has highlighted interesting trends. The approach to learning preference for deep and strategic approaches to learning reflects earlier findings (Smith & Mathias, 2010). Furthermore, in this study there was a lower per cent of students adopting a surface approach. If learning approach is an indicator of a course's quality (Sternberg & Zhang, 2001) then these are certainly very encouraging results. The relationship between approach to learning and answers to the anatomy learning experience questionnaire revealed that students who adopted a surface approach felt that the dissecting room was an effective environment to learn in and that they were learning other things, this is not in line with previous literature and the findings may conflict each other. The students that day may have been new to the material or may have been overwhelmed by the amount to study during that session but at the same time find the environment a positive experience. Students who adopted a strategic approach unsurprisingly explained that their main motivation was to pass examinations, this reflects previous literature (Smith & Mathias, 2007; Ward, 2011, Smith et al., 2014). Students who adopted a strategic approach reported finding the dissecting room a daunting environment but this was perhaps superseded by their motivation to achieve.

Specific analysis of the ALE questions revealed students' positive attitudes towards dissection. Beyond being a valued learning resource, dissection appears to act as an important introduction to medicine and podiatry, like a rite of passage. Some say cadavers are students' first patients, through which students deal with death and develop a 'professional distance'. Several relationships of interest were found between ALE questions and personality. Taking the strongest associations, it is perhaps not surprising that individuals who are very conscientious understood the importance of anatomy in clinical practice, used anatomical terms at clinical opportunities, and felt the course allowed them to use their knowledge. Within the facets of conscientiousness, achievement striving was highly correlated with statements that might be expected e.g. the main motivation was to pass examinations.

Two ALE questions had a statistically significant correlation with exam results in the medical cohort. Unsurprisingly, there was a negative correlation between lacking confidence in their anatomy knowledge and students' exam results. Secondly, the use of anatomy terminology in clinical scenarios correlated positively with exam results. This could be considered a deep approach as it involves understanding, lateral thinking and the ability to put knowledge into context. This finding highlights the importance of tying anatomy into clinical skills (Vasan et al., 2011; Azer, 2011; Bockers et al., 2014). Here we see that the 19th Century view that anatomy should be clinically orientated still rings true today.

Limitations

Limitations to the study should be noted. Firstly, the questionnaires were only completed once, meaning the results only reflect one moment in time. As learning approach can change with time depending on the context, it would have been useful to repeat the questionnaires later. Secondly, the three disciplines do not follow the same anatomy curriculum, or have the same teaching experience of anatomy which could limit the generalizability of the findings. However, as both Podiatrists and Medical students have dissection room sessions using human cadavers it was felt appropriate that only these two groups complete the ALE.

Conclusion

In thinking about the learning environment, it clear that there are numerous interplays between the environment and the effect on learning. There is considerable debate about the use of cadavers for learning anatomy. Predominately, literature researching medical students suggests it can be an effective strategy in the promotion of a deep approach to learning and is worth the time and money spent on its pursuit (Utting &Willan 1995; Quince et al., 2011). Dissection offers an opportunity for three-dimensional exploration and discovery and can generate some very meaningful discussions. The findings of this study support the use of human cadavers on anatomy. Studies on podiatry students are inadequate now and more is needed in this area to advocate or refute the use of cadavers in teaching anatomy to podiatry students.

This study adds evidence to a niche and poorly explored area of medical and allied health education. In keeping with the literature, features of a deep and strategic approach are commonly used to learn anatomy. This has important implications for curriculum reform which should be aimed at supporting a deep approach and recognizing traits associated with a strategic approach. It would be of future interest to evaluate if approach to learning and personality is related to a student's ability to predict and understand their own knowledge (Hall et al., 2016). Distribution of ASSIST data is in line with trends from previous studies which have shown that a strategic followed by a deep approach are the preference for students. The high percentage of students who adopt a strategic approach reflects the reality of the pressures of assessments. It also suggests the good integration and the teaching engagement that exists in anatomy that places the learning in context for students.

Some of the results related to personality are perhaps not surprising but place for the first-time confirmation in believed perspectives of teachers. e.g. you would expect a student who adopted a strategic approach to score highly on 'mean achievement striving' because they tend to be driven by grades/achievement. It is interesting that these students scored higher for conscientiousness than the students who took a deep approach. It may be that in the school education system and higher education that strategic approaches are the only way to survive, and perhaps the best way to perform conscientiously under conditions of high work load and competing demands.

Take Home Messages

- Personality remains a fixed trait that is useful to explore in understanding students' learning.
- Approach to learning is plastic and is affected by the learning environment and my personality.
- Anatomy learning should recognise the different approaches a student may adopt and offer different multimodal opportunities for learning.
- Human cadavers remain is an essential part of anatomical education.
- Students studying for medicine, podiatry and pharmacy have similar approaches to learning anatomy and perspectives of their learning environment.

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Appendices

Declaration of Interest

The author has declared that there are no conflicts of interest.